

XLIV. *On Caprification as practised upon the Figs in the South of Europe and the Levant, with Descriptions of the Insects employed for that Purpose; and Observations upon the Agaon paradoxum of Dalman.* By J. O. WESTWOOD, F. L. S., &c.

[Read 2d January, 1837.]

It is one of the most interesting portions of the study of natural history to trace those higher relations which exist amongst the great divisions of nature, and to endeavour to discover the effects of each upon each. The botanist, for instance, who looks beyond the technical details of his science, strives to ascertain the relations of particular tribes of plants with particular geographical and geological districts; and the ornithologist discovers in the prominent features of a landscape, whether of rock, vale or flood, the peculiar character of the feathered tribes inhabiting the spot.

In Entomology hitherto but very little has been done in this branch of the study of nature, and which has been almost entirely confined to the connexion existing between certain insects and plants, having for its object the impregnation of the latter, or the removal of the entire pollinific masses, whereby the plant is rendered abortive. The most interesting observations upon this subject hitherto published are those by Professor Willdenow, in the "*Grundriss der Kräuterkunde*," by whom *Aristolochia Clematidis* is described as possessing such a structure that the anthers cannot impregnate the stigma, which office is performed by a minute *Tipula* (probably a *Cecidomyia*), several of which enter the throat of the flower, and are unable to return, in consequence of a lining of dense hair, which is directed downwards, but which, as soon as the pollen has been deposited upon the inclosed stigma, shrinks so as to enable the enclosed insects to escape. In like manner, in those species of plants which have the male flowers on one plant and the female upon another, as well as in those which have the stamens in one flower and the pistil in another, the impregnation is also almost universally performed by insects; and Sprengel asserts, that, in order to prevent hybridism, insects which derive honey or pollen from different plants indiscriminately, will during a whole day confine their visits to that species on which they first fixed in the morning, provided there be a sufficient supply of it; and Kirby and Spence notice a passage by

Dobbs, in the forty-sixth volume of the Philosophical Transactions, to the same effect.

On the other hand, it may be remembered, that at a former meeting of this Society a memoir by M. Morren was read, in which the agency of insects in preventing the impregnation of the *Asclepiadææ*, by the removal of the entire pollinific masses, was described. (See Transact. Ent. Soc. Vol. i. App. p. xliv.)

The process of caprification seems, however, to be the most important instance in which insects are employed in promoting the developement of vegetables. This process, as described by Theophrastus, Plutarch, Pliny, and other ancient writers, corresponds with what is practised at the present time in the Archipelago and in Italy. These authors all agree in declaring that the wild fig-tree, *Ficus caprificus*, never ripened its own fruit, but was absolutely necessary for ripening that of the garden or domestic fig. The reason of this success has been supposed to be, that by the punctures of certain insects the vessels of the latter fruit are wounded, and a consequently increased action in the nutritious juices is induced; whilst some authors have supposed, that the wound is accompanied by the emission of a fluid somewhat analogous to that supposed to be discharged by the common gall flies, and which, fermenting gently with the milk of the figs, makes the flesh of the fruit more tender. In confirmation of this view, it is stated that the figs in Provence, and even at Paris, ripen much sooner for having their buds pricked with a straw dipped in olive oil, considerable changes happening to the contexture of fruits so pricked, just as to parts of an animal pierced with any sharp instrument. Other authors again have maintained that by penetrating into the centre of the fruit, the insects form a passage for the free admission of the air and sun.

Linnæus, however, explained the process by supposing that the insects brought the farina from the wild fig, which contained only male flowers, to the domestic fig, which contained only female flowers. And I have the authority of Professor Don and Dr. Dickson, both eminent botanists, for adopting this view of the subject, the structure of the female flower being moreover of such a character as to require the interference of an insect for effecting its impregnation. Latreille also states that "les insectes qui en sortent (that is, from the wild figs) chargés de poussière fécondante s'introduisent par l'œil dans l'intérieur des secondes figues, fécondent par ce moyen toutes les graines, et provoquent la maturité du fruit."—*Hist. Nat.* tom. xiii. p. 204.

M. Bernard, however, opposes this explanation, stating, in the

Memoirs of the Society of Agriculture, that he could never find the insect in the cultivated fig, and that in reality it did not quit the wild fig until the stamina were mature, and their farina dissipated, adding that what they might have brought on their wings must be rubbed off in the little aperture which they form for themselves. At Malta, where there are seven or eight varieties of the domestic fig, this operation is only performed on those which ripen latest; the former are asserted to be of a proper size and full flavour without it; whence he adopts the opinion stated above, namely, that caprification only hastens the ripening. He examined the parts of fructification of the fig, and observes that if this examination be made previously to the ripening, there may be observed round the eye of the fig, and in the substance of its covering, small triangular dentated leaves pressed close one against another; and under these leaves are the stamens, whose pollen is destined for the impregnation of the grains, which fill the rest of the fruit. These male organs are much more numerous in the wild fig than in the domestic, and the stamens are found to contain a yellow dust, which may be collected when it is ripe. The wild figs when ripe are not succulent and have no taste, though the grains are disposed in the same way as in the other kind. The pith of the grain of the wild fruit serves as food to a small Hymenopterous insect, whose larva is white till the moment of its transformation, and it is by an opening in the direction of the pistil that the insect penetrates the grain. From these circumstances it is thought probable that the insect is only communicated by accident to the domestic fig, and that the flowers of this genus are sometimes hermaphrodites. But the number of hermaphrodite flowers being fewer on the cultivated than on the wild fig, the seeds are fecundated more certainly and quickly by the caprification; and every botanist knows that when impregnation is completed, the flower soon withers, while, if by any accident it is delayed, it continues to bloom much longer. This view of the subject therefore explains very completely the reason why, in Malta, the caprification is practised on the late kind of figs, because it hastens the formation and maturity of the fruit.

Dr. Lindley, in the Penny Cyclopædia (art. *Caprification*), adopts this view of the operation, observing that fruits *bitten* by insects ripen sooner than others, the wound appearing to act as a stimulant to the local action of the parenchyma; hence branches of the wild fig, infested with the *Cynips Pscnes*, are introduced into the fig orchards, when the cultivated figs are preparing to become ripe, when the insects attack the latter and pierce the fruit, which

thus ripens sooner, enabling the growers to obtain two crops in a year, although the process is said to deteriorate the fruit. In opposition to this statement, the celebrated entomologist Olivier, who was for a considerable time in the Archipelago, affirms that this practice of caprification “ n'est autre chose qu'un tribut que l'homme paye à l'ignorance et aux préjugés ; parcequ'en France, en Italie, en Espagne, et dans plusieurs contrées du Levant, où la caprification n'est pas connue, on y obtient des figes bonnes à manger.”—*Now. Dict. d'Hist. Nat.* art. *Caprification*. It is however affirmed by other authors that a skilful caprification rewards the dexterous husbandman with a much larger increase of fruit than could otherwise be produced, and that a tree of the same size, which in the south of France, where caprification is not practised, may produce about twenty-five pounds of fruit, will by that art, in the Grecian islands, bring ten times that quantity ; and it will be observed that Olivier does not attempt to show that the “ figes bonnes à manger ” had not been naturally instead of artificially visited by insects.

The accounts given by Pontedera and Tournefort of the manner in which this curious operation is performed, are very precise ; that of the former is contained in the *Anthologia*, and that of the latter in the *Voyage to the Levant*, and in a memoir delivered to the Academy of Sciences at Paris, in 1705. Tournefort's account is as follows :—“ Of the thirty species or varieties of the domestic fig-tree which are cultivated in France, Spain, and Italy, there are but two cultivated in the Archipelago. The first species is called *Ornos*, from the old Greek *Erinos*, which answers to *Caprificus* in Latin, and signifies a wild fig-tree. The second is the domestic or garden fig-tree. The former bears successively in the same year three sorts of fruit, called *Fornites*, *Cratitires*, and *Orni* ; which, though not good to eat, are found absolutely necessary towards ripening those of the garden fig. These fruits have a sleek even skin, are of a deep green colour, and contain in their dry and mealy inside several male and female flowers, placed upon distinct foot-stalks, the former above the latter. The *Fornites* appear in August, and continue to November without ripening ; in these are bred small worms, which turn to a sort of gnats, no where to be seen but about these trees. In October and November these gnats of themselves make a puncture into the second fruit, which is called *Cratitires*. These do not show themselves till towards the end of September. The *Fornites* gradually fall away after the gnats are gone ; the *Cratitires*, on the contrary, remain on the tree till May, and inclose the eggs deposited by the

gnats when they pricked them. In May the third sort of fruit, called *Orni*, begins to be produced by the wild fig-trees. This is much bigger than the other two, and when it grows to a certain size, and its buds begin to open, it is pricked in that part by the gnats of the *Cratitires*, which are strong enough to go from one fruit to another to deposit their eggs. It sometimes happens that the gnats of the *Cratitires* are slow to come forth in certain parts, while the *Orni* in those very parts are disposed to receive them. In this case the husbandman is obliged to look for the *Cratitires* in another part, and fix them at the end of the branches of those fig-trees, whose *Orni* are in a fit disposition to be pricked by the gnats. If they miss the opportunity, the *Orni* fall, and the gnats of the *Cratitires* fly away; none but those that are well acquainted with the culture know the critical moment of doing this, and in order to know it, their eggs are perpetually fixed on the bud of the fig, for that part not only indicates the time that the insects are to issue forth, but also when the fig is to be successfully pricked; if the bud is too hard and compact the gnat cannot lay its eggs, and the fig drops when the bud is too open.

“The use of all these three sorts of fruit is to ripen the fruit of the garden fig in the following manner. During the months of June and July the peasants take the *Orni* at the time their gnats are ready to break out, and carry them to the garden fig-trees; if they do not nick the moment, the *Orni* fall, and the fruit of the domestic fig-tree not ripening, will in a very little time fall in like manner. The peasants are so well acquainted with these precious moments, that every morning in making their inspection they only transfer to their garden fig-trees such *Orni* as are well conditioned, otherwise they lose their crop. In this case however they have one remedy, though an indifferent one, which is to strew over the garden fig-trees another plant in whose fruit there is a species of gnat, which answers the purpose in some manner.”

In this account the insects are termed gnats, but it is quite evident, from the observations of all subsequent authors, that the insect here alluded to is either the Hymenopterous insect called *Cynips Psenes* by Linnæus, or one very closely allied thereto. It also appears certain that the eggs of the insect are deposited in the immature fruit, since the latter at a more advanced period are described as containing the larvæ, which subsequently bring forth another brood of the insect. Nevertheless we are still in ignorance of many points in the natural history of the insect, a knowledge of which would alone enable us to form a precise idea as to its mode of operation.

Pontedera has indeed given us a more minute account of the insect, which appears from his figures (*Anthol.* Tab. xi), notwithstanding its rudeness, to be a minute Hymenopterous insect, and also a figure of the infested fruit, with numerous botanical details. He states that he had noticed both sexes of his insect, and that the females were furnished with an exserted ovipositor; his figures however do not represent this appendage, and are probably those of the males. He found "larvas horum cynipum singulas in singulis germinibus ficus caprificæ;" and adds, "se hæc insecta quidem in caprificæ grossis nunquam autem in pomis ficus satiræ, nec in erinosyces serotinis, in quibus stamina et apices non reperiuntur, invenisse."

Hasselquist, in his *Resa til heliga Landet* (Stockh. 1757, p. 424, *et seq.*), describes three Hymenopterous insects, under the names of *Cynips Ficus*, *C. Caricæ*, and *C. Cycomori*.

The habits of the first of these insects, *Cynips Ficus*, are described thus: "Ficus fæminas inhabitat, quorum germina excavata ab illo repiri et in quovis fere germine unum reconditum. An Cupido Ficus qui farinam genitalem ex caprifico in ficum transfert? Gallæ locum obtinet heic ficus; germina corrodit insectum quod plus damni quam utilitatis fructui adfert. An hæc progenita officio deinde fungitur mediatorio?"

The second is described thus: "In eadem cum altero (*C. Ficus*) Ficu habitat. An præcedens ex altero sexu? an diversa species?"

The third, *C. Cycomori*, is merely described as inhabiting the fruit of the *Ficus Cycomorus*.

Linnæus, who was the tutor of Hasselquist, in the subsequent edition of the *Systema Naturæ*, united the *C. Ficus* and *C. Caricæ* together, under the name of *Cynips Pscnes*, referring not only to Hasselquist's two species, but also to the figures of Pontedera. He also gave the *C. Cycomori* as distinct, with the observation, "Habitat in Ægypti ficus Sycomori grossis. Fuscus, aculeo longitudine corporis exserto, sed debili, laxo, ut vix videatur Cynips esse. Antennæ thorace breviores, subulatae, basi crasso, conicæ!"

Dr. Gravenhorst has published a very interesting memoir, in the *Beitrag zur Entomologie*, of the Natural History of Silesia, Part I. having for its title "Disquisitio de Cynipe Psene auctorum, et descriptio Blastophagæ novi Hymenopterorum generis." The new genus *Blastophaga* described in this memoir is established upon a single species, *Bl. grossorum*, respecting whose habits the following observations are made: "Collega æstumatisissimus Dr. L. C. Treviranus coloniam mecum communicavit Hymenoptero-

rum parvorum, circa ducentorum, e grossis Ficus Caricæ feræ natorum quos e comitatu Tyrolensi adportaverat. Grossi floribus masculis et femineis repleti erant, germina autem omnia, perpaucis exceptis incolumibus inania et foraminibus singulis parvis rotundis percussa conspiciebantur. E his foraminibus Hymenoptera ista provenerant postquam larvæ eorum interanea germinum comederant et intra putamen intactum mutationem subierant." He then gives a minute description of the individuals of this colony, all of which were described as females, and as having the ovipositor "longitudine dimidiæ aut tertiæ partis abdominis;" and observes, "E vitæ ratione horum animalculorum conjiciebam ea ad Cynipem Psenen Linnæi referenda esse." He then introduces a disquisition upon the insects described by Pontedera and Hasselquist: and points out the differences in structure and habits between his insect and the genus *Cynips* and the *Chalcididæ*; concluding thus, "Num Cynips Ficus et Cynips Caricæ Hasselquistii vitæ ratione omnino cum nostra Blastophaga congruentes, num forsitan quoque Cynips Sycomori Hasselquistii ad unum idemque genus cum illa redigendi sint, haud dijudicare queo cum species istas nec ipsas viderim, nec satis accurate descriptas invenerim."

I am fortunately enabled to clear up some of the doubts entertained by the author last quoted relative to some of these insects, extraordinary not only in their economy, but also in the peculiarity of their structure. In the Linnæan cabinet are preserved a considerable number of specimens, ticketed by Linnæus himself *Cynips Sycomori*, and doubtless forming portions of those brought from Egypt by Hasselquist himself. A minute examination of these insects has enabled me not only to ascertain their generic identity with the *Blastophaga* of Gravenhorst, but also to discover the real affinity of the anomalous genus *Agaon* of Dalman.

BLASTOPHAGA SYCOMORI. (Plate XX. Fig. 4.)

Ex individuis Linnæanis descripta.

Caput magnum, ovatum, depressum, lateribus subrotundatis, fossulâ longitudinali dorsali; oculis mediocribus lateralibus, ocellis obsoletis? *Antennæ* capite paulo longiores, ad marginem anticum capitis insertæ, 12-articulatæ; articulo 1mo magno, ob-conico; 2do minori, ad apicem ejus lateraliter inserto; 3tio subgloboso; 4to tenuiori, apice in spinam acutam lateralem exeunte; 5to minimo, angulariter præcedenti affixo; reliquis septem subæqualibus, ultimo tamen parvo conico, (tribus ultimis clavam subclavam formantibus). *Mandibulæ*

magnæ, subquadratae, conicæ, ad apicem internè bidentatæ, extus ciliatæ, et versus basin alulâ corneâ tenui, haud articulatâ, obovali, reflexâ, fere mandibularum magnitudine, transversè 5-serratâ, instructæ. *Maxillæ* minutæ, membranaceæ, lobo apicali rotundato et externè ciliato, et setâ parvâ loco palporum instructæ. *Mentum* minutum, membranaceum, compressum. *Labrum* minutum, ciliatum, exsertum, palpis obsoletis.

Thorax depressus, collari semicirculari; mesothorace parvo, parapteris distinctis; scutello magno; metathorace transverso.

Alæ anticæ maximæ, nervo subcostali, ad apicem cum costâ coalito nervoque parvo deflexo curvato, ad apicem subclavato.

Alæ posticæ angustæ, enerves.

Pedes antici breves; femoribus maximis, obovatis, compressis; tibiis brevissimis, subtriangularibus; tarsis 5-articulatis, articulis 4 basalibus minutis, æqualibus, ultimo elongato, unguibus duobus parvis pulvilloque intermedio. *Pedes* intermedii formæ ordinariæ, graciles; tarsis 5-articulatis. *Pedes* postici incrassati; femoribus ovatis, compressis, basi parum constrictis; tibiis brevissimis, subtriangularibus, tarsis elongatis, 5-articulatis.

Abdomen depressum, sessile, breve, obovatum, oviductu abdominis dimidii fere longitudine; oviductu ipso gracillimo, vaginis longiori, his crassioribus, pilosis.

Color piceus, capitis parte anticâ antennarumque basi rufescentibus, harum apicibus fuscis; pedibus luteis; alis limpidis, punctato-pilosis, ciliatis; nervis fusciscentibus.

Long. corp. lin. $\frac{7}{8}$. Expans. alar. lin. $1\frac{3}{4}$.

Fig. 4 a, underside of the head; 4 a*, head seen laterally; *, the basal joint of the antenna; †, the mandibular appendage; o, the eye; 4 b, one of the mandibles, with its appendage; 4 c, ditto, seen laterally; 4 d, the mandible detached from 4 e, the appendage; 4 f, the latter seen laterally; 4 g, the maxillæ and labium in situ; 4 h, the two maxillæ; 4 i, the mentum seen laterally; 4 k, the terminal joints of the antennæ; 4 l, fore-leg; 4 m, middle leg; 4 n, hind-leg; 4 o, abdomen seen laterally.

The extraordinary appendage to the base of the mandibles is totally unlike any thing which I have ever observed before. Gravenhorst describes the trophi in his *Blastophaga* thus: "Oris partes haud distinctè visui patent, utrinque tamen palpus crassiusculus reflexus ovate orbiculatus, petiolatus clavatus subquadriannulatus (quadriarticulatus) conspicitur." The part here described as the palpus is certainly identical with the appendage above de-

scribed in *Blastophaga Sycomori*, and is in no manner connected with the maxillæ or labium, which parts are destitute of appendages, except a minute spur in the place of the maxillary palpi.

The singular form of the antennæ, and of the anterior and posterior legs, is also quite unlike that of any other insects with which I am acquainted.

I am indebted to Dr. Klug for specimens of another curious insect, "*ex ficibus Ægypti*," which in several respects agrees with *Blastophaga Sycomori*, although in several of its more particular characters it cannot be associated therewith. I have therefore formed a new genus for its reception. The specimens are all females.

SYCOPHAGA. Genus novum.

(Σύκων, *ficus*, et φαγῶν, *edo.*)

Caput thoracis latitudine, posticè latius, anticè subattenuatum, fossulâ longitudinali dorsali. *Antennæ* versus partem anteriorem fossulæ insertæ, capite paulo longiores, 14-articulatæ; articulo 1mo elongato maximo, subcylindrico; 2do minori, duobus proximis minimis, annuliformibus; articulis 6 proximis longitudine fere æqualibus, at gradatim crassioribus, ultimis 4 clavani ovalem formantibus. *Mandibulæ* magnæ, acutæ, ad apicem subfalcatæ, subtriangulares, in medio externè emarginatæ et ciliatæ, intus edentatæ. *Maxillæ* minutæ, membranaceæ, lobo apicali angustiori, internè ciliato, spinâ minutâ loco palporum. *Mentum* elongatum, basi attenuatum; *labium* setis elongatis rigidis instructum, palpibus biarticulatis. *Oculi* mediocres, laterales; *ocelli* haud distincti.

Thorax elongato-quadratus, collari magno anticè attenuato. *Alæ* magnitudine mediocres, nervis ut in *Blastophagâ*, at nervo deflexo ferè recto.

Pedes ut in *Blastophagâ*.

Abdomen depressum, obovatum, versus basin angustius; *oviductus* trisetosus, setis æqualibus, abdomine duplo longioribus et valdè incurvatis.

Sycophaga crassipes. (Plate XX. Fig. 5.)

Piceo-nigra, thorace depresso, æneo submicanti; pedibus magis subrufescentibus, femoribus supra obscurioribus, tarsis pallidioribus; oviductu rufo, vaginis pallidè luteis, apice nigris, pilosis; antennis nigro-piceis.

Long. corp. lin. $1\frac{1}{8}$. Expans. alar. lin. $1\frac{1}{2}$.

Fig. 5 a, underside of the head; 5 b, mandible; 5 c, maxillæ and labium in situ; 5 d, maxilla; 5 e, labium; 5 f, antenna; 5 g, fore-leg; 5 h, middle leg; 5 i, hind-leg; 5 k, abdomen seen sideways.

On reviewing the characters of the two insects above described with those of *Agaon paradoxum* of Dalman, an insect which has greatly perplexed Entomologists, it immediately occurred to me that I here possessed the true affinities of that extraordinary insect (of which a specimen has lately been presented to the British Museum by the Rev. Mr. Morgan), which also possesses a deep occipital fossula, in the front part of which the antennæ are inserted. The wings are furnished with the same single deflexed nerve, and the description given by Dalman of the appendages of the mouth corresponds with that of *Blastophaga*. "Palpos detegere non valui, sed media pars capitis subtus tegitur lamellis duobus recumbentibus parallelis relicta rimâ angustâ inter se, quæ ad mandibularum basin insertæ sunt, elongatæ cultriformes, capite arcte applicatæ et basin ejus attingentes." The ovipositor of this insect is very similar to that of *Sycophaga*, but the antennæ are terminated by three very large and distinct joints, and the legs are simple.

I regret that I cannot speak with precision as to the precise affinities of these insects. Dalman observes of the *Agaon*, "Ex allatis satis liquet insectum hocce ad ordinem Hymenopterorum pertinere, quorum ad familias et Pteromalinarum et Codrinorum accedere videtur, ob ani structuram priori forte potius associandum." He however describes the wings as being "forma et facie fere ut in Diapriâ."

Latrielle placed *Agaon* next to *Eurytoma* amongst the *Chalcididæ*, and it seems to me unquestionable that the curious little groups above described are certainly referable to that family rather than to the *Proctotrupidæ*. From all these insects however they are at once removed by their fruit-feeding habits, as well as by various anomalous portions of their structure, so that I hesitate to name any particular group in that family to which they ought to be considered as most nearly allied.

It is to be hoped that some future traveller in the East will enable us therefore to solve the difficulties which still exist respecting these curious insects, by the discovery of the sexes, and a more precise account of their habits.

I take this opportunity of introducing the following notes relative to the *Chalcis pyramidea*, Fabr., referred to in the Journal of Proceedings, Vol. ii. p. xxx. (5th December, 1836.)

From a sketch made of the specimen of this insect contained in the Fabrician Collection at Kiel, in 1835, as well as from the identity of its habits with that figured in pl. 20, fig. 6, which was procured by Mr. Sells from the nest of *Chartergus nidulans* (of which it was regarded by Réaumur as the female), I have not the least doubt that the two are specifically identical, although upon a minute comparison of Mr. Sells's specimens with the Fabrician description, several minute discrepancies are discoverable, as may be observed from the following description of the former.

CHALCIS PYRAMIDEA. Fabr. Syst. Piez. p. 163, No. 15.

(*Chalcis conica*. Fabr. Ent. Syst. Suppl. p. 242.)

Var. ♀ : facie omnino nigra, tegulis albidis macula basali nigra ; femoribus 4 anticis nigris, apice albidis ; tibiis anticis albis, subtus linea nigra ; tibiis intermediis fascia media nigra ; femoribus posticis nigris, externe linea dorsali albida, denticulisque 12 ; tibiis posticis nigris, supra linea albida, tarsi omnibus albidis, unguibus pulvillisque nigris ; capite thoraceque punctato, scutello areolato apice obtuse bispinoso ; abdominis segmentis duobus apicalibus utrinque puncto spiraculiformi ut in generibus *Ibalia* et *Leucospide*.

Long. corp. lin. 5.

Obs.—Specimina quatuor e nido *Chartergi nidulantis* exclusa omnino conveniunt.

Ad subgenus nostrum *Brachymeriam* pertinet.



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